97. (Amended) The method of performing ophthalmic surgery according to claim 91, wherein: [successive]

pulses of said ultraviolet laser beam corresponding to adjacent ablation spots on said single ablation layer overlap one another by [are overlapped] at least 50 percent.

98. (Amended) The method of performing ophthalmic surgery according to claim 91, wherein: [successive]

pulses of said ultraviolet laser beam corresponding to adjacent ablation spots on said single ablation layer overlap one another [are overlapped] in a range of 50 to 80 percent.

105. (Amended) The method for performing corneal refractive surgery according to claim 90, wherein [:] said scanning mechanism comprises:

a galvanometer.

106. (Not Amended) The method for performing corneal refractive surgery according to claim 90, further comprising:

aligning a center of said scanning laser beam onto said corneal surface with a visible aiming beam.

Remarks

Claims 1-24, 26, 28-30, 32, 35-41, 43-49, 53-55, 57-60, 63-72, 75, 76, 78, 80-83, 85, 87-91, 93-95, 97, 98, 105 and 106 remain pending in the application.

Stipulation that Lai is prior art

The Applicants hereby stipulate that PCT Application No. PCT/US92/09625 filed internationally on November 5, 1992, claiming priority from U.S. Appl. No. 788,424 filed November 6, 1991, ("Shui Lai application")

while bearing a publication date later than the filing of the present application, nevertheless constitutes the state of the art at the time of the present invention. Thus, the Applicants admit *a priori* that any U.S. patent which might issue in the future as a counterpart to PCT/US92/09625 may be considered today by the Examiner as prior art.

This statement is intended to moot any suspension of the present application pending disposition of the Shui Lai application, as suggested by the Examiner, and is intended to instead allow the Examiner to consider the merits of the present application in light of the teachings of Shui Lai.

Shui Lai reference

The numerous distinctions of the claims of the present invention from the teachings of Shui Lai are discussed in detail in the First Supplemental Amendment filed on September 8, 2000. The Examiner is respectfully requested to review that Amendment with respect to his consideration of Shui Lai.

In particular, as discussed in the First Supplemental Amendment, Shui Lai teaches the use of a fundamentally **infrared**, **high power** laser (150 mJ or greater exiting from an output window of the basic laser) scanned in a **non**-overlapping manner, with offsets of pulse locations being caused by intentional offsets of ablation layers.

This constitutes **three** separate and important distinctions from the claims of the present invention, which variously recite a fundamentally ultraviolet, low power laser (10 mJ or less from an output window of a basic laser) scanned in a purposefully, substantial overlapping manner (50-80%) on a single ablation layer.

Supported in specification

The following discusses support for such distinctions as recited in the claims using references to the specification of the original patent.

Support for: 10 mJ or less exiting from the output window of a basic laser

The contrasts between the prior art high power lasers (100 mJ and greater) and the low power laser (10 mJ exiting from the output window of the basic laser) used in the disclosed embodiments of the present invention are clearly explained in the specification to one of ordinary skill in the art.

For instance, the present invention discloses the use of a basic laser **10** in Fig. 1 (not the entire laser head **20** including the scanning device and other optics) as including a compact, argon fluoride excimer laser (at 193 nm) with repetition rate of (1-1,000) Hz, and energy per pulse of (0.5-10) mJ. (col. 8, lines 61-64) In another preferred embodiment, the basic laser **10** is a compact, low-cost, low-power (energy of 1 to 10 mJ per pulse) argon fluoride excimer laser at 193 nm. (col. 4, lines 52-54) These energy levels (less than 10 mJ) relates to the energy of the laser beam exiting the basic laser **10**, not to an energy level of the laser beam applied to the corneal surface. This would be clear to a person of ordinary skill in the art.

In the Background of the Invention section, it is explained that an object of the invention is to provide an overlapping scanning system which enables use of a low-energy basic laser. (Col. 1, lines 40-44)

In contrast, prior art systems required high powered lasers having energy of (100-300 mJ) per pulse from the laser cavity, or (30-40 mJ) per pulse delivered onto a corneal surface. (col. 2, lines 17-19) These prior art systems are explained to be less than 10% efficient in converting energy from the output of the laser window to the corneal surface. (col. 1, lines 40-41; col. 3, lines 1-3) Not only are such high power basic lasers inefficient, they exhibit higher system and maintenance costs (e.g., more gas), larger size/weight, and greater sensitivity to environmental conditions such as temperature and moisture. (col. 2, lines 27-32)

An essential feature of the present invention is explained as the use of a laser which requires less energy, e.g., ranging between 0.05-10 mJ per pulse, to enable one to make refractive lasers at lower cost, smaller size, and

with less weight (by a factor of 5-1) than that of high power prior art lasers. (col. 4, lines 6-13)

Support for: Overlapping such that adjacent spots on a single ablation layer significantly overlap one another

The present inventors recognized that non-overlapping pattern ablation systems (e.g., L'Esperance and Lai) introduce additional complexity. For instance, non-overlapping pattern ablation systems require substantially uniform density laser beams, which in turn requires high power basic lasers (100-200 mJ) (col. 2, lines 40-45) Non-overlapping systems also require registration accuracy to within a desired roughness of the final surface.

Typically, because of the non-overlapping patterns, such equipment requires complex apparatus to select a uniform density section of the laser beam. (col. 2, line 65-col. 3, line 1) This further reduces efficiency between the energy output from a window of the conventional high power basic laser and ablation energy applied to the cornea, resulting in the tendency of prior art systems to include higher power basic lasers-not lower power basic lasers.

The present invention went against this conventional wisdom by using a much, much smaller basic laser, having much, much less power than those in conventional systems. Because the basic laser had much lower power, efficiency was important as between the energy output from an output window of the basic laser and the energy ultimately applied to the corneal tissue.

Significant overlap of pulses provided a solution. Significant overlap of pulses not only reduced or eliminated the need for a masking or selection of only a uniform density portion of the laser beam, but because of the higher efficiency (e.g., 50% efficiency as compared to 10% efficiency in prior art systems), low power lasers could be implemented.

Significantly overlapped pulses is not obvious

Overlapping ablation pulses is straight forward from conventional equipment which purposely avoided overlap but for overlap caused by tolerances in the equipment. Smooth ablation layers is important in achieving an overall

smooth ablation. L'Esperance and Lai each teach that smooth ablation can be best achieved by using a mosaic of pulses, preferably not overlapping. While Lai recognized that some overlap might occur due to tolerances, those of skill in the art would appreciate that where such overlap did occur, it caused deviations from a smooth ablation in that ablation layer, which was to be avoided.

Moreover, according to prior art systems, the greater the overlap, the longer the procedure (which was to be avoided). Thus, those of ordinary skill in the art would have, at best, tended to *reduce* overlapping, if any, not only to achieve the desired smooth ablation, but also to reduce procedure time.

The present invention balances a recognition of a generally longer procedure time necessary to overlap pulses, against numerous advantages with a low power laser, e.g., reduced size/weight of the basic laser, avoidance of ridges present in prior art systems, etc., resulting in a reduction in cost of equipment.

Conclusion

It is respectfully submitted that the subject application is in condition for allowance and a Notice to that effect is earnestly solicited.

Respectfully submitted,

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